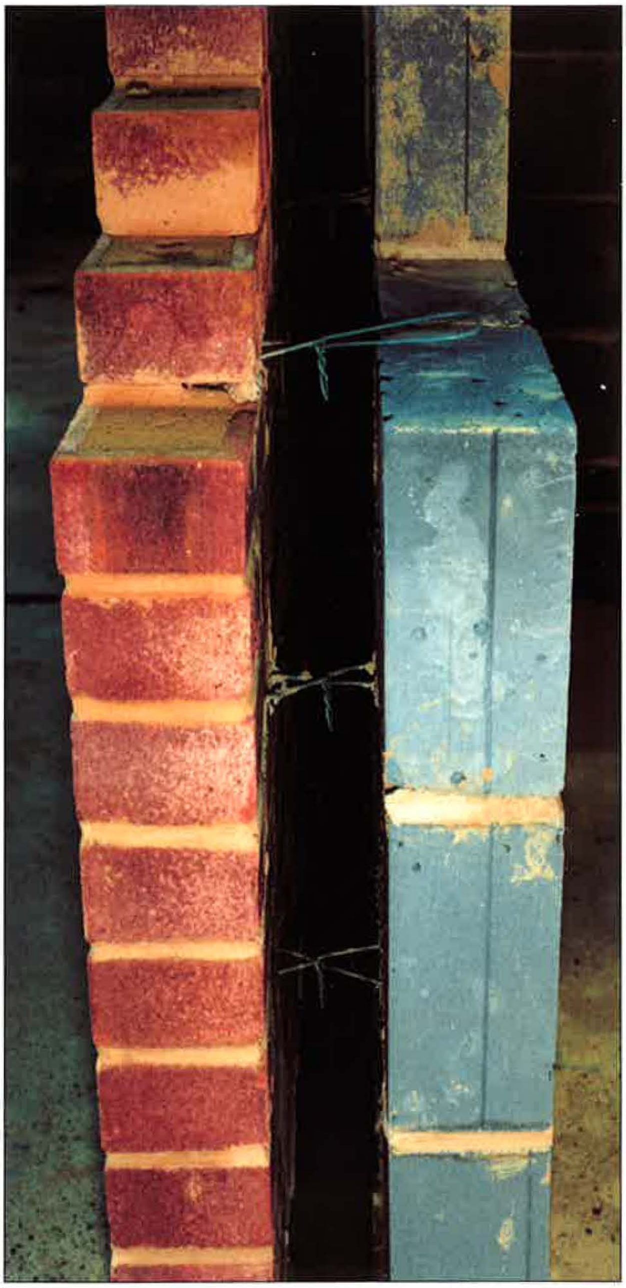
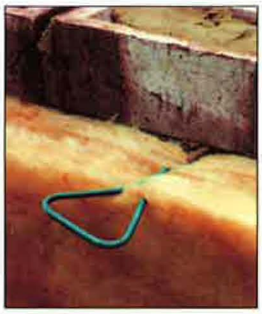
Good Practice

Guide 95

ENERGY EFFICIENCY IN NEW HOUSING

Detailing for designers and building professionals





EXTERNAL CAVITY WALLS

“A U-value of 0.35 W/m²K has been chosen as a target value for the external walls of energy efficient new dwellings”

BEST PRACTICE PROGRAMME

Energy Efficiency Office
DEPARTMENT OF THE ENVIRONMENT

BEST PRACTICE PROGRAMME

Contents

Foreword

This Guide is one of a series produced by BRECSU for the EEO under the title *Energy efficiency in new housing: detailing for designers and building professionals.* The other Guides in this series are:

- Good Practice Guide 93 – *Key detailing principles*
- Good Practice Guide 94 – *Ground floors*
- Good Practice Guide 96 – *Windows and external doors*
- Good Practice Guide 97 – *Pitched roofs.*

To complement these Good Practice Guides there is a companion series with the title *Energy efficiency in new housing: site practice for tradesmen.* The following are relevant to external cavity walls:

- Good Practice Guide 102 – *Injected cavity insulation*
- Good Practice Guide 103 – *Full fill insulation batts*
- Good Practice Guide 104 – *Partial fill insulation*
- Good Practice Guide 105 – *Insulated dry lining.*

A U-value of 0.35 W/m^{2}K, which can be achieved cost-effectively, has been chosen as a target value for the external walls of energy efficient new dwellings and has been used throughout this Guide.

The structure of the Guide

This Guide is divided into six Sections. The first five deal with the main ways of insulating external cavity walls:

- injected or blown cavity insulation
- full fill insulation batts
- partial fill cavity insulation
- clear cavity with insulated dry lining
- services and service entries.

Section 6 deals with assessing exposure to driving rain.

To make comparisons between alternative methods of insulation easier, each Section is structured in the same way.

- Introduction with 'Features' box
- Construction options
- The main technical risks
- An explanation of each technical risk in turn, with a list of the key detailing points to either avoid, or minimise the risk
- Specification Notes
- Buildability Points

Acknowledgements
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ENERGY EFFICIENCY IN NEW HOUSING

Detailing for designers and building professionals

INTRODUCTION

This Section deals with the detailing of a masonry cavity wall with injected or blown cavity insulation. It also illustrates a typical window opening detail, using an insulated top hat lintel and proprietary insulated cavity closers.

In some parts of the country there may be a preference for walls to be built with a clear cavity with the insulation introduced upon completion. This may be because of restrictions on the use of certain cavity insulation methods or because it is felt that it is better to ensure that the wall is built correctly before introducing thermal insulation into the cavity.

The same standards of detailing and construction are, however, equally applicable to walls insulated at the time of construction.

Good practice detailing of these walls follows the recommendations in BS 5618, BS 5628 : Part 3 and BS 8208.

CONSTRUCTION OPTIONS

The main construction options are:

- external finish
- width of cavity and insulation material
- type of masonry for inner leaf
- internal finish.

Table 1 sets out the main options.

Where a lightweight aircrete inner leaf is used, a U-value of 0.35 W/m^{2}K can be achieved by filling a 75 mm wide cavity with injected insulation such as expanded polystyrene (EPS) beads, mineral wool or urea formaldehyde (UF) foam.

Increasing the cavity width to 100 mm not only increases the resistance of the wall to rain penetration but also allows a denser blockwork to be used for the inner leaf.

FEATURES

- Traditional methods of cavity construction need not be changed.
- With a clear cavity it is easy to look down and check that the cavity is clean and that wall ties and cavity trays are correctly installed.
- Bricklaying is not interrupted by the addition of insulation.
- Wall tie positioning at openings is unaffected by the presence of insulation.
- The insulation value of the wall can be achieved easily by filling the cavity with insulation material.
- The need to cut insulation boards or batts at complicated junctions is eliminated.
- Damage to stored insulation materials is avoided.

Polystyrene beads being injected

EXTERNAL CAVITY WALLS

Injected or blown cavity insulation

Items	Range of construction options			
External leaf	Facing brick *	Rendered block	Cladding on block	
Insulation	EPS beads *	Mineral wool	UF Foam	
Inner leaf blockwork	Lightweight aircrete	Standard * aircrete	Medium density	Dense
* Options illustrated by the photographs in this Section				

Table 1 Construction options for walls with injected or blown cavity insulation

"Increasing the cavity width to 100 mm not only increases the resistance of the wall to rain penetration but also allows a denser blockwork to be used for the inner leaf"

INJECTED OR BLOWN CAVITY INSULATION

MAIN TECHNICAL RISKS

The main technical risks with this form of construction are:

- **rain penetration** if the wall is not adequately protected from wind driven rain, if it is not designed and constructed to the standards set out in BS 5628 : Part 3, or if it is used in too exposed a location
- **thermal bridging** at reveals where windows and doors are built into the outer leaf and do not overlap an insulated cavity closer
- **air infiltration** around openings, where there are gaps through the inner leaf to the interior, eg where joists are built into the wall, where services and other components pass through and around the edges of a dry lining.

DETAILING AGAINST RAIN PENETRATION

A wall can be detailed to resist rain penetration by:

- the correct use of dpcs and cavity trays
- increasing cavity width
- ensuring that projections throw water clear of the wall.

Recommendations on good practice appear in BS 5628 : Part 3, the BRE Report *Thermal insulation: avoiding risks* and the NHBC Guide, *Thermal insulation and ventilation.*

The **key detailing points** follow.

- Projections at sills, copings and below cladding should be not less than 50 mm and incorporate a throating. The projection may be less in Sheltered or Very sheltered exposure zones.
- All interruptions to the cavity, eg doors, windows, air bricks, should have cavity trays to direct water to the outside.
- Ventilation openings through the wall should be sleeved across the cavity and be protected by a cavity tray.
- Cavity trays (or lintel profiles) should rise at least 140 mm between outer and inner leaves and at least 100 mm across the cavity (see Diagram 1).

External leaf	Cavity	Cavity width	Cavity insulation	Maximum exposure category
Masonry finished with impervious cladding	Filled	50 mm	EPS Mineral wool UF foam	Very severe
Fairfaced masonry (tooled joints) with impervious cladding above ground storey	Filled	75 mm	EPS Mineral wool	Severe
			UF foam	Sheltered/moderate
		100 mm	EPS Mineral wool	Very severe
Masonry with render	Filled	50 mm	EPS Mineral wool UF foam	Severe
Fairfaced masonry (tooled joints) with or without render above ground storey	Filled	75 mm	EPS Mineral wool	Severe
			UF foam	Sheltered/moderate

Notes: 1 Care should be taken when specifying external blockwork to be rendered.
2 Information on exposure categories is given in Section 6.

Table 2 Maximum exposure categories for injected and blown cavity insulation

- Lintels should have separate cavity trays (returned into the inner leaf) in Severe and Very severe exposure zones and always when a brick soldier course is used above the opening.
- Cavity trays should be self-supporting or fully supported with any joints lapped and sealed.
- Weepholes above cavity trays should be at 450 mm centres with a minimum of two per lintel.
- Closely spaced openings should have a continuous cavity tray over the short piers and be detailed to allow for lintels of different heights.
- Cavity trays (or lintels acting as cavity trays) in walls fully filled with insulation should have stop ends to prevent water running off the ends into the insulation (see Diagram 2).
- The cavities of gable walls should preferably be completely filled to the verge, or alternatively filled to at least 225 mm above ceiling level and protected by a cavity tray/dpc and weepholes at 450 mm centres (see Diagram 3).

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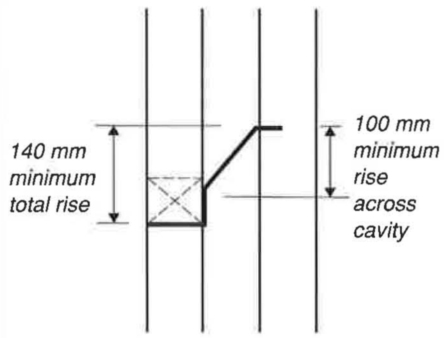
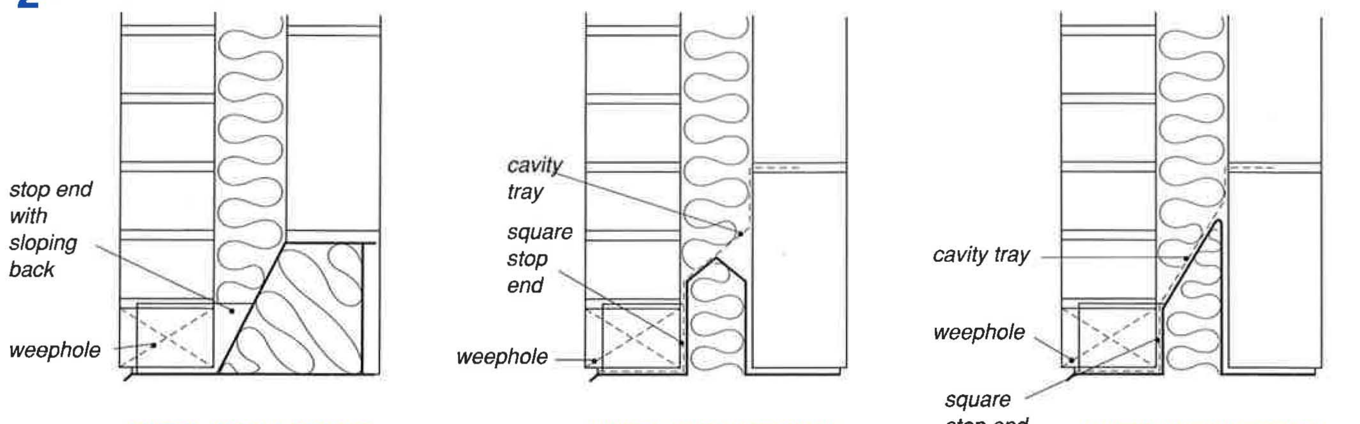


Minimum cavity tray dimensions

2

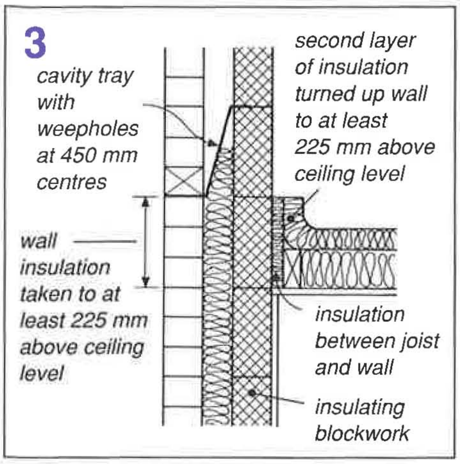


LINTEL WITH A SIMPLE SLOPE WITHIN THE CAVITY

LINTEL WITH VERTICAL FRONT OVER 75 mm HIGH

LINTEL WITH VERTICAL FRONT UNDER 75 mm HIGH

Detailing the stop ends to suit the lintel profile

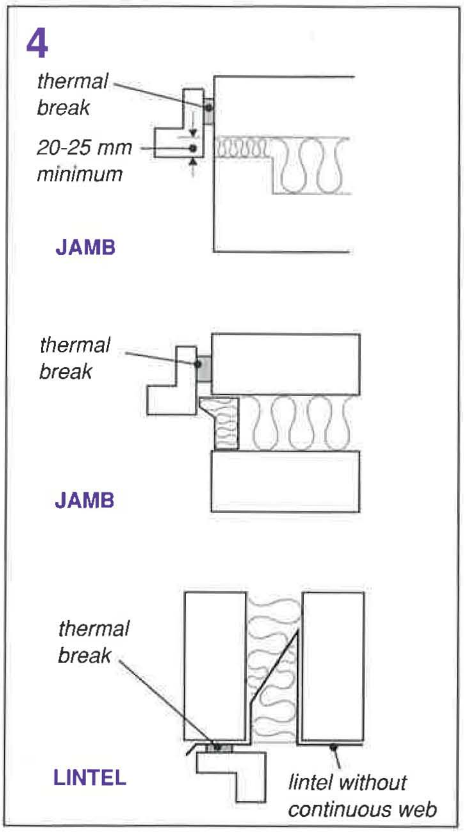


Gable wall/loft junction

- Mortar joints to fairfaced brickwork should be bucket-handle or weather-tooled. The use of recessed joints for walls with fully filled cavities is only recommended in areas of Sheltered or Very sheltered exposure.
- Adding render or cladding to the wall can increase its resistance to rain penetration (see table 2).
- Painted finishes on fairfaced masonry should be avoided with fully filled cavities as they can reduce the rate at which the wall dries out and so increase the risk of frost damage.

DETAILING TO AVOID THERMAL BRIDGING

When cavity walls are filled with insulation, there is no thermal bridge through the wall itself, except at junctions with ground floors and roofs, where there can be a risk of condensation if dense masonry is used for the inner leaf.



Ways of avoiding a thermal bridge

Sill with good overhang

A thermal bridge around window and door openings can be avoided if the thermal resistance of the materials which close the cavity is sufficient to maintain the internal surfaces of the reveal at a temperature which will generally avoid the formation of condensation.

The **key detailing points** follow.

- Where the window frame is set back behind the outer leaf by only 25 mm, it is necessary to use a closer with very good thermal insulation properties, such as a proprietary unit containing expanded polyurethane foam. These units also serve to fix the window frame to the wall when the frame is built-in (see Diagram 4).
- The lintel should also be fully insulated immediately behind the window frame and ideally not have a continuous steel web between the outside and inside (see Diagram 4).
- It is also an advantage to introduce an insulated thermal break between the window frame and the lintel, jamb and sill, in the form of a strip of expanded foam (when windows are built-in) or polyurethane foam (when windows are installed in prepared openings).
- It is recommended that an insulating block with a thermal conductivity no greater than 0.30 W/m·K is used for the inner leaf of the cavity wall to avoid a thermal bridge where loft insulation meets a gable end.

For further advice on detailing to avoid thermal bridging, see EEO Good Practice Guide 93.

DETAILING AGAINST AIR INFILTRATION

Air infiltration can be reduced by minimising the number of occasions that holes are made in the masonry and by specifying suitable methods of sealing any residual gaps.

The **key detailing points** are:

- Timber floors should be supported on joist hangers, not built into the inner leaf.
- Seal around all services and components which pass through the inner masonry leaf. Details of sealing gaps around services is given in Section 95.5.

For further advice on detailing against air infiltration, see EEO Good Practice Guide 93.

SPECIFICATION NOTES

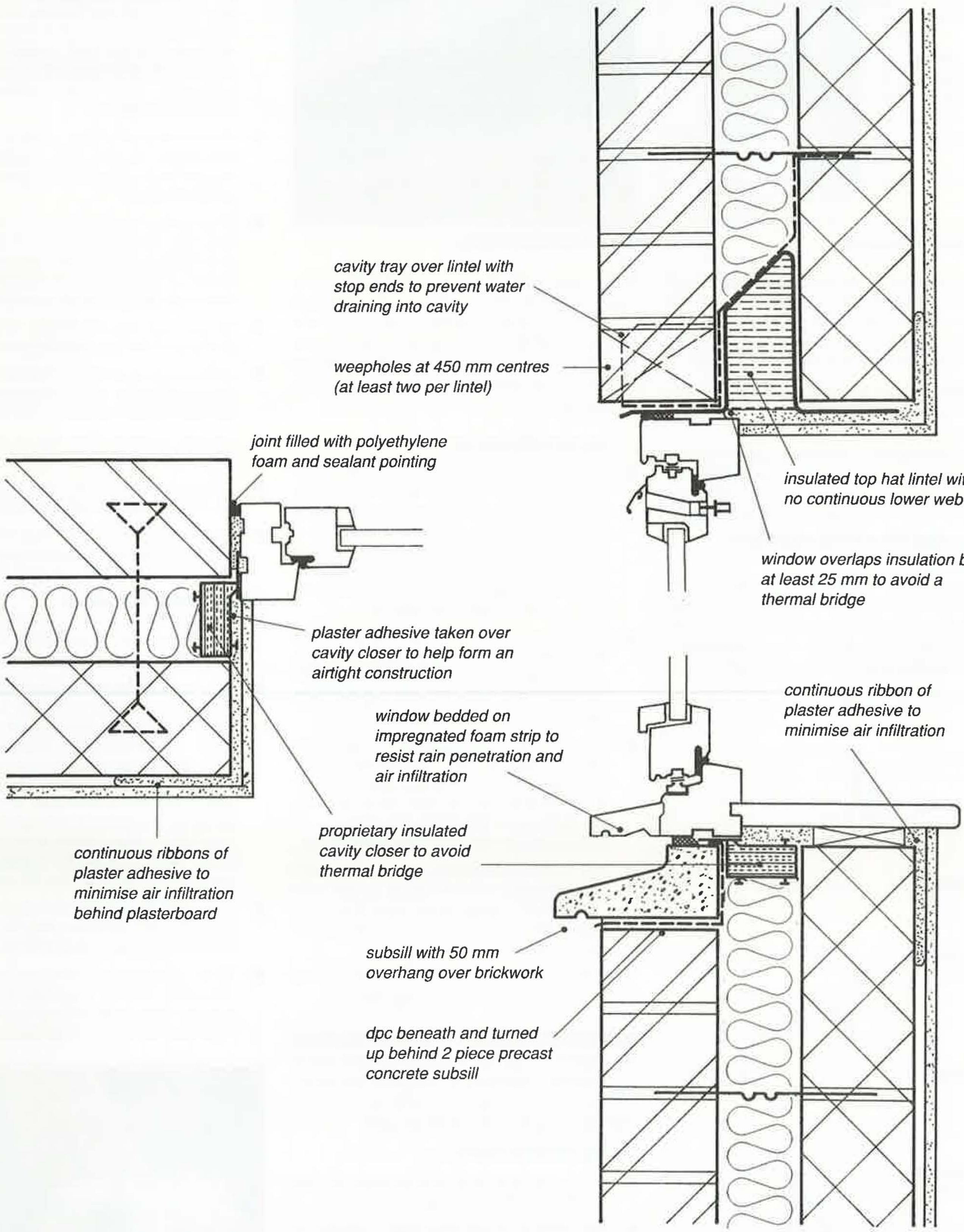
- Wall constructions should be chosen to suit the local exposure of the proposed building (see table 2).
- The frost resistance of the outer leaf should be sufficient for the degree of exposure to wind driven rain and freezing temperatures. Clay bricks should be designated frost resistant (F in BS 3921 : 1985) for all sills, copings, etc and where the combination of exposure and frost incidence are exceptionally Severe.
- Avoid using too strong a mortar for facing brickwork as this can cause hairline cracks which downgrade the exposure rating of the wall.
- When using aircrete blocks for the internal skin, dry lining will avoid the problem of shrinkage cracks. Specify continuous ribbons of adhesive to the perimeter of each area of dry lining to avoid air infiltration.
- Choose wall ties of sufficient length to bed at least 50 mm into each masonry leaf.
- Choose a type of wall tie that is suitable for the cavity width and compatible with the strength of the blockwork inner leaf.
- Choose stainless steel ties in Severe and Very severe exposure zones.
- Porous bricks absorb rainwater and reduce the risk of rain penetration through mortar joints.
- Stop ends for cavity trays within filled cavities should be chosen to suit the profile and slope of the cavity tray (see Diagram 2).

BUILDABILITY POINTS

- Allow for the thickness of the dpc/cavity tray in addition to the dimension of the lintel within the cavity when specifying cavity width.
- Site measurements show that the width of a cavity wall can vary in line and verticality by up to 10 mm. The introduction of factory-made components with fixed dimensions, such as insulated cavity closers, into the cavity needs to be considered in relation to these variations in tolerance. It is preferable to allow an extra 5 mm on the size of proprietary cavity closers when determining cavity width to avoid the possibility of the cavity being narrower than the closer.
- Where different sized openings are separated by short piers, consider using the same lintel height to ease detailing and construction.
- When polystyrene beads are injected into the cavity, choose a system with adhesive to avoid loose beads falling out of the cavity if the wall ever needs to be opened up.

Insulated closer and thermal break

Typical window opening detail in a wall designed for injected or blown cavity insulation



ENERGY EFFICIENCY IN NEW HOUSING

Detailing for designers and building professionals

EXTERNAL CAVITY WALLS

Full fill insulation batts

INTRODUCTION

This Section deals with cavity walls in which insulation batts of mineral or glass wool are built into the cavity during construction. It illustrates a typical window opening using an insulated box lintel and insulation installed in the jamb return.

The detailing standards applicable to walls with a clear cavity are equally applicable to walls which are fully filled with insulation batts. Good Practice detailing of these walls follows the recommendations in BS 5628 : Part 3 and BS 8208.

CONSTRUCTION OPTIONS

The main construction options are:

- external finish
- width of cavity
- type of masonry for inner leaf
- internal finish.

Table 3 shows the combinations of insulation thickness and inner leaf blockwork that can achieve a U-value of 0.35 W/m²K or less with a fairfaced brick outer leaf and a plaster internal finish.

With fairfaced brickwork, and a lightweight aircrete inner leaf, a cavity width of 65 mm is necessary to achieve a U-value of 0.35 W/m²K.

Increasing the cavity width to 100 mm not only allows a denser block to be used but also increases the resistance of the wall to rain penetration.

FEATURES

- High insulation standards are readily achievable.
- Increasing the cavity width to 75 mm or more gives greater resistance to rain penetration than a nominal 50 mm cavity and increases the insulation value.
- The detailing requirements are largely the same as for a clear cavity wall.
- Cavity insulation can avoid thermal bridging problems at wall/floor junctions and at separating walls.
- The mineral wool batts used in full fill constructions are non-combustible.

The first row of batts installed

Insulation thickness [mm]	U-values with different types of blockwork for inner leaf [W/m²K]			
	Dense [2000 kg/m³]	Medium density [1400 kg/m³]	Standard aircrete [650 kg/m³]	Lightweight aircrete [480 kg/m³]
65				0.32
75			0.33	0.3
100	0.31	0.3	0.27	0.25

KEY [shaded] Combinations where the U-value is greater than 0.35 W/m²K, assuming no allowance is made for thermal bridging.

Note: the figures assume an outer leaf of 102 mm brickwork, an inner leaf of 100 mm blockwork and an internal finish of 12 mm gypsum plaster.

Table 3 Cavity walls with built-in full insulation that achieve U-values better than 0.35 W/m²K

“Avoiding rain penetration depends on both the quality of the design and the quality of the workmanship”

MAIN TECHNICAL RISKS

The main technical risks with this form of construction are:

- **rain penetration** if the wall is not adequately protected from wind driven rain, if it is not designed and constructed to the standards set out in BS 5628 : Part 3, or if it is used in too exposed a location
- **thermal bridging** at reveals where windows and doors are built into the outer leaf and do not overlap an insulated cavity closer
- **air infiltration** around openings, where there are gaps through the inner leaf to the interior, eg where joists are built into the wall, where services and other components pass through and around the edges of dry lining.

DETAILING AGAINST RAIN PENETRATION

A wall can be detailed to resist rain penetration by:

- the correct use of dpcs and cavity trays
- increasing cavity width
- ensuring that projections throw water clear of the wall.

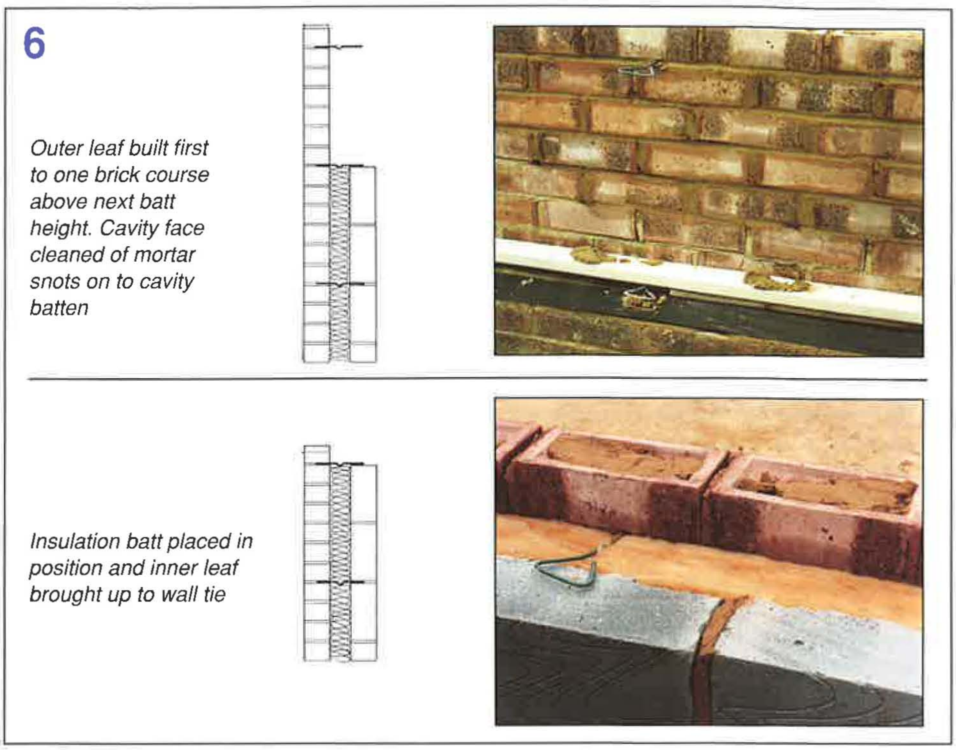
Recommendations on good practice appear in BS 5628 : Part 3, the BRE Report *Thermal insulation: avoiding risks* and the NHBC Guide, *Thermal insulation and ventilation.*

Avoiding rain penetration depends on both the quality of the design and the quality of the workmanship. EEO Good Practice Guide 103 sets out the key points for site supervisors to look out for.

The **key detailing points** set out on page 4 are equally applicable to cavity walls that are fully filled during construction.

The following design features can help to reduce rain penetration by limiting the amount of water that runs down the surface of the walls:

- overhanging eaves and verges
- projecting sills, copings and string courses
- projecting flashings below areas of cladding.



Recommended construction procedure

The more generous the overhang, the greater the protection (see Diagram 5).

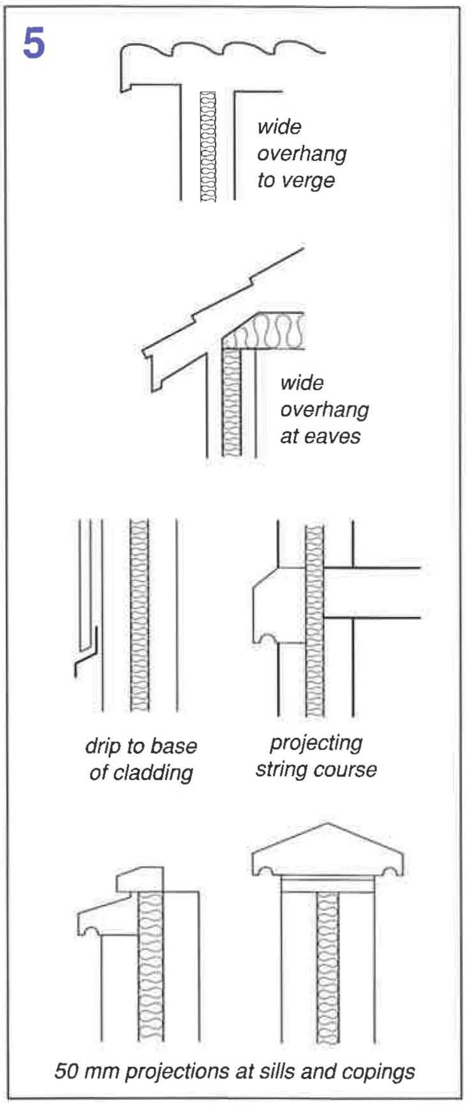
Increasing the cavity width of a wall reduces the risk of rain penetration. Table 4 sets out a range of cavity wall constructions and their maximum recommended exposure category. In locations where an external finish, eg render or cladding is normal practice, the finish should continue to be specified.

Fairfaced brickwork should have bucket-handle or weather-tooled joints to increase its resistance to rain penetration. Recessed mortar joints create a much greater risk of water entering the cavity and should be avoided, except in conditions of Sheltered exposure.

Construction of the outer leaf first, enables the cavity face to be cleaned of mortar snots and pointed up to minimise the risk of rain penetration (see Diagram 6).

External leaf	Minimum cavity width [mm]	Maximum exposure category
Masonry with full height cladding (eg tile hanging)	50	Very severe
Masonry with full height rendered finish	50	Severe
Facing brick on ground storey with cladding to walls above	50	Severe
	100	Very severe
Facing brick on ground storey with rendered walls above	50	Severe
Facing brick (tooled mortar joints)	50	Sheltered/moderate
	75	Severe
Facing brick (recessed mortar joints)	50	Sheltered

Table 4 Maximum exposure categories for walls with built-in full fill insulation batts



Protective design features

DETAILING TO AVOID THERMAL BRIDGING

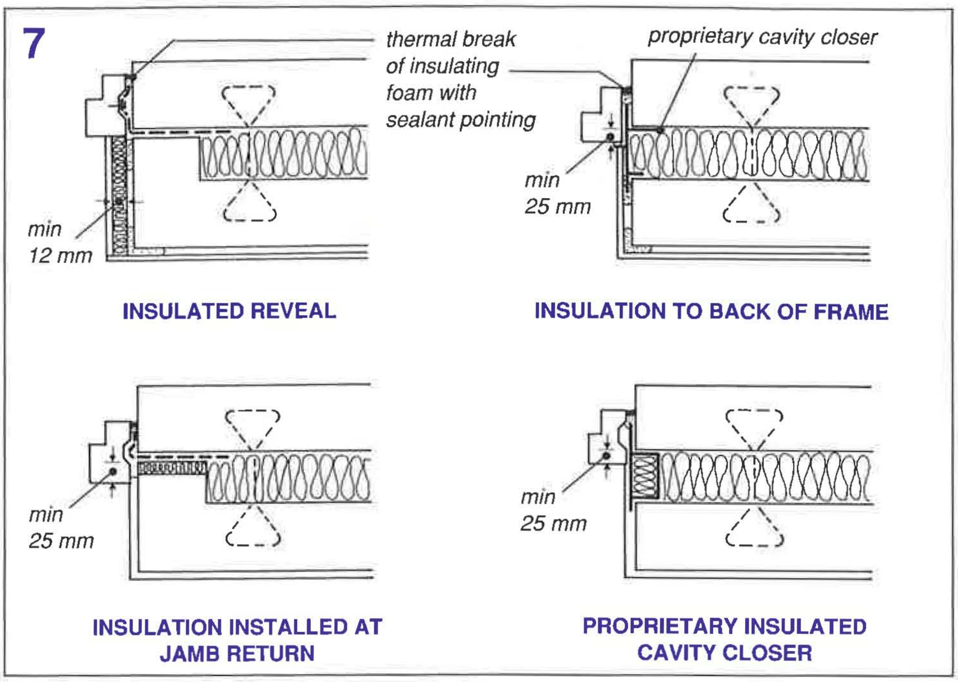
When cavity walls have full fill insulation batts built in during construction, there is no thermal bridge through the wall itself, but there are potential weak points at the junction with ground floors and roofs, and around window and door openings. This can result in condensation on the inner leaf.

The **key detailing points** follow.

- At the junction with the ground floor, start the cavity insulation at least 150 mm below the finished slab level. The first row of batts may either be supported by wall ties, or built straight off the concrete cavity infill.
- At window and door openings:
  - insulate the reveal and soffit, or
  - set the window back so that it laps insulation at the jamb return by at least 25 mm (see Diagram 7).
- When windows are set back, it is necessary to use a subsill to achieve the 50 mm overhang of the outer leaf.
- Lintels should be insulated and ideally not have a continuous horizontal steel web between the outside and inside.
- It is also an advantage to introduce an insulated thermal break between the window frame and the lintel, jamb and sill, in the form of a strip of expanded foam or expandable polyurethane foam (see Diagram 7).
- At the eaves, the 1992 revision to Approved Document B no longer requires fully filled cavities to have a cavity closer at the top of the wall, so the wall and roof insulation can be detailed as one continuous layer.
- It is recommended that an insulating block with a thermal conductivity no greater than 0.30 W/m·K is used for the inner leaf to avoid thermal bridging between the cavity and loft insulation at gable ends.

DETAILING AGAINST AIR INFILTRATION

Air infiltration can be reduced by limiting the number of occasions that holes are made in the masonry and by specifying suitable methods of sealing any residual gaps.



Ways of avoiding a thermal bridge at the jamb

The **key detailing points** follow.

- Timber floors should be supported on joist hangers, not built into the inner leaf.
- Seal around all services and components which pass through the inner leaf. Details of sealing gaps around services are given in Section 95.5.

For further advice on detailing against air infiltration, see EEO Good Practice Guide 93.

SPECIFICATION NOTES

The specification notes for a wall with injected or blown cavity insulation, as listed out on page 5, are equally applicable to walls with built-in cavity insulation batts.

In addition, there are further specification notes that relate to the insulation batts themselves.

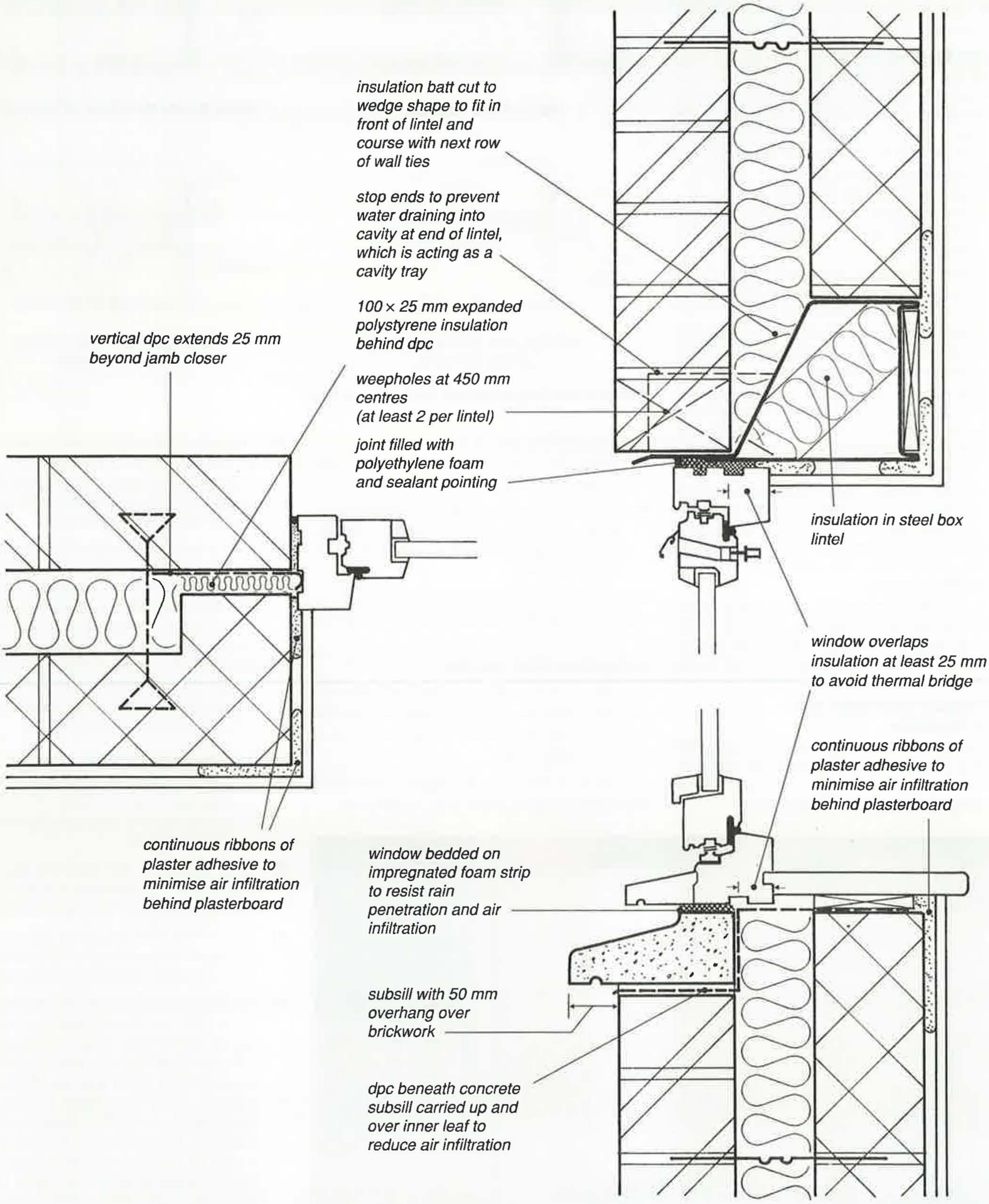
- Check that the height of the insulation batts is compatible with the coursing of the masonry being used, 455 mm high for wall ties at 450 mm centres and 405 mm high for wall ties at 400 mm centres.
- The cavity width should not be less than the thickness of the insulation batts. Standard thicknesses which can achieve a U-value of 0.35 W/m^{2}K are 65 mm, 75 mm and 100 mm. The resilience of batts that are wider than the structural cavity can be enough to push bricks out of position before the mortar has set. On the other hand, if the structural cavity is too large, the batts can tilt forward and the risk of rain penetration is increased.

BUILDABILITY POINTS

- The cavity width as built should not be greater than the insulation thickness by 10 mm for 65 mm batts and 15 mm for 75 and 100 mm batts.
- Allow 10 mm for the dpc and associated mortar when determining the thickness of any reveal insulation used with reveal blocks.
- Allow for the thickness of the dpc/cavity tray in addition to the dimension of the lintel within the cavity when determining cavity width.
- Site measurements show that the width of a cavity wall can vary in line and verticality by up to 10 mm. The introduction of factory-made components with fixed dimensions, such as insulated cavity closers, into the cavity needs to be considered in relation to these variations in tolerance. It is preferable to allow an extra 5 mm on the size of proprietary cavity closers when determining cavity width to avoid the possibility of the cavity being narrower than the closer.
- Where different sized openings are separated by short piers, consider using the same lintel height to ease detailing and construction.

An insulated jamb return

Typical window opening detail in a wall designed for built-in full fill insulation batts



ENERGY EFFICIENCY IN NEW HOUSING

Detailing for designers and building professionals

INTRODUCTION

This Guide deals with cavity walls in which cavity insulation boards or slabs partially fill the cavity.

Partial cavity fill is preferred by designers who wish to achieve good insulation values (0.35 W/m²K or better) whilst maintaining a 50 mm wide clear cavity to avoid rain penetration. It avoids the need for a thick insulated internal lining that can place limitations on wall fixings.

The detailing standards applicable to unfilled cavity walls are equally applicable to cavity walls with partial fill cavity insulation, although particular care may be needed in detailing at lintels, jambs and sills because of the greater structural cavity width necessary with partial cavity fill. Good practice detailing follows the recommendations in BS 5628 : Part 3.

CONSTRUCTION OPTIONS

The preferred location for partial fill insulation is to fix it against the inner leaf. With the insulation in this position:

- water that penetrates into the cavity can run down the inner face of the outer leaf, as with traditional clear cavity construction, without being hindered by the insulation
- air movement in the clear cavity will help dry the outer leaf
- cold air permeating the outer leaf will remain on the cold side of the insulation and is less likely to circumvent the partial fill insulation.

FEATURES

- A clear cavity is maintained immediately behind the outer leaf.
- It is easy to check that the cavity is clean and that wall ties and cavity trays are correctly installed.
- The detailing requirements are largely the same as for a clear, unfilled cavity wall.
- Partial fill cavity insulation avoids thermal bridging problems at junctions with separating walls and other internal walls, partitions and intermediate floors.
- Structural cavities need to be 80 mm to 100 mm wide to achieve U-values of 0.35 W/m²K.

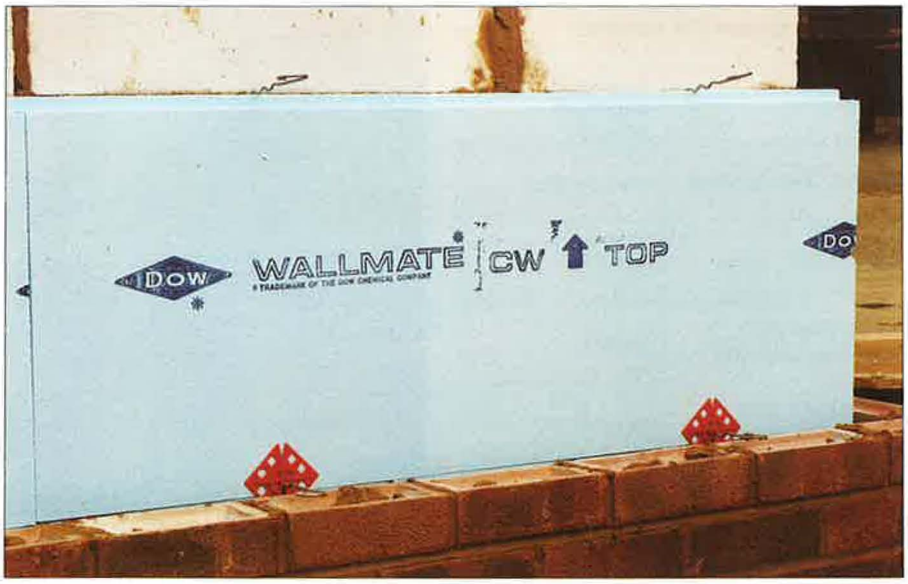
Fixing partial fill insulation against the outer leaf is not recommended since air leakage between the cavity and the outside air can greatly reduce the value of the insulation. It is also not recommended by NHBC, even though permitted by certain BBA Certificates.

There are a number of insulants that are used for partial fill boards and slabs. Table 5 shows the thicknesses of insulants that can achieve U-values better than 0.35 W/m²K in combination with three commonly used masonry inner leaves.

The use of insulation-faced blockwork is an alternative to partial fill boards and slabs. However, the range of products currently available that can achieve a U-value of 0.35 W/m²K is very limited and therefore not covered in this Section.

EXTERNAL CAVITY WALLS

Partial fill cavity insulation



"Partial cavity fill is preferred by designers who wish to achieve good insulation values whilst maintaining a clear cavity to avoid rain penetration"

MAIN TECHNICAL RISKS

The main technical risks with this form of construction are:

- **rain penetration** if the wall is not adequately protected from wind driven rain, if it is not designed and constructed to the standards set out in BS 5628 : Part 3, or if it is used in too exposed a location
- **thermal bridging** at reveals where windows are built into the outer leaf without overlapping an insulated cavity closer
- **air infiltration** around openings, where there are gaps through the inner leaf to the interior, eg where joists are built into the wall, where services and other components pass through and around the edges of dry lining
- **thermal performance** is reduced if external air can circulate behind the insulation.

DETAILING AGAINST RAIN PENETRATION

A wall can be detailed to resist rain penetration by:

- the correct use of dpcs and cavity trays
- maintaining a clear 50 mm cavity
- ensuring that projections throw water clear of the wall.

Recommendations on good practice appear in BS 5628 : Part 3, the BRE Report *Thermal insulation: avoiding risks* and the NHBC Guide, *Thermal insulation and ventilation.*

Avoiding rain penetration depends on both the quality of the design and the quality of the workmanship. EEO Good Practice Guide 104 sets out the key points for site supervisors to look out for.

The key detailing design points to avoid rain penetration set out on page 4 are equally applicable to cavity walls with partial fill insulation.

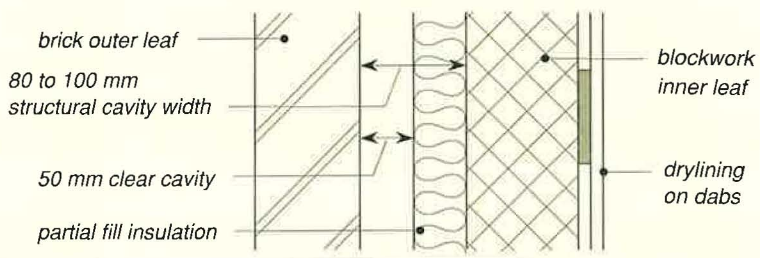
Table 6 sets out the maximum exposure categories recommended for different external leaf constructions in combination with partial fill insulation.

In locations where rendering or cladding of walls is normal practice, the external finish should continue to be specified.

For fairfaced brickwork to be suitable in areas of Severe exposure, the mortar joints should be bucket-handle or tooled. Recessed mortar joints allow water to enter the cavity more easily and are only suitable for areas with Sheltered or Very sheltered exposure categories.

The recommended width for the clear cavity is 50 mm. This results in the structural cavity width being 50 mm wider than the thickness of the partial fill insulation.

In order to maintain a clear 50 mm cavity and to prevent boards from tilting over and blocking the cavity, they must be firmly held in place against the inner leaf. This is normally achieved by means of proprietary retaining discs fitted to the wall ties. The manufacturers of the partial fill insulation recommend particular wall ties and retaining discs that are suitable for their products.



Partial fill insulation	Insulation thickness	U-values with different types of blockwork for inner leaf [W/m²K] Medium density [1400 kg/m³]	Standard aircrete [650 kg/m³]	Lightweight aircrete [480 kg/m³]
Polyurethane faced with aluminium foil [λ=0.023 W/m·K]	30 mm			0.33
	35 mm		0.34	0.31
	50 mm	0.31	0.28	0.26
Extruded polystyrene [λ=0.027 W/m·K]	40 mm			0.33
	50 mm		0.32	0.29
Expanded polystyrene [λ=0.037 W/m·K]	50 mm			0.34
Mineral wool [λ=0.33 W/m·K]	50 mm			0.33

KEY (shaded) Combinations where the U-value is greater than 0.35 W/m²K, assuming no allowance is made for thermal bridging.

Table 5 Cavity walls with partial fill that achieve U-values better than 0.35 W/m²K

The **key detailing points** for wall ties follow.

- The ties should be spaced at 600 mm horizontally and 450 mm centres vertically in rows, ie not staggered as with normal cavity constructions. This is to ensure that each full insulation board or slab is held in place by four retaining discs (see Diagram 8).
- Where it is necessary to cut the insulation, eg below sills or the eaves, it is not possible to secure the insulation in place with the wall ties. In these cases, large headed galvanised nails should be pushed through the insulation at 450 mm horizontal centres into the 'green' mortar joints of the blockwork.
- The design of the wall tie should ensure that it forms a drip in the centre of the clear cavity when used with the intended thickness of partial fill insulation.

External leaf	Maximum exposure category
Masonry with cladding	Very severe
Masonry with render	Severe
Facing brick (with tooled mortar joints)	Severe
Facing brick (with recessed mortar joints)	Sheltered
Note: assumes a 50 mm clear cavity	

Table 6 Exposure categories for walls with partial fill cavity insulation

An insulated reveal showing a correctly positioned wall tie with retaining disc

DETAILING TO AVOID THERMAL BRIDGING

For cavity walls with partial fill insulation, there is no thermal bridge through the wall itself, but there are potential weak points at the junctions with ground floors and roofs and around window and door openings.

The **key detailing points** are mainly the same as those on page 9 for fully filled cavities. The main exception is that cavity closers must be provided at the top of all walls where the insulation only partially fills the cavity. To prevent a thermal bridge at this point, the cavity should be closed with a non-combustible board (such as 9 mm calcium silicate board – see Diagram 9) or an insulating block with a thermal conductivity no greater than 0.30 W/m•K. Dense blocks and bricks should not be used to close the cavity.

For further advice on detailing to avoid thermal bridging see EEO Good Practice Guide 93.

DETAILING AGAINST AIR INFILTRATION

Air infiltration can be reduced by limiting the number of occasions that holes are made in the masonry and by specifying suitable methods of sealing any residual gaps.

The **key detailing points** follow.

- Timber floors should be supported on joist hangers, not built into the inner leaf.
- Seal around all services and components which pass through the inner masonry leaf. Details of sealing gaps around services are given in Section 95.5.

For further advice on detailing against air infiltration, see EEO Good Practice Guide 93.

DETAILING TO AVOID LOSS OF THERMAL PERFORMANCE

For partial fill insulation to achieve its designed thermal performance, it is vital that cold external air is prevented from getting between the insulation layer and the inner leaf. While good detailing can help, the most important aspect is good workmanship and site supervision, particularly removing mortar snots so that insulation can fit tightly against the true face of the inner leaf.

The **key detailing points** follow.

- The partial fill insulation should be held tightly against the inner leaf by retaining discs or clips.
- The insulation should be detailed to fit tightly around all penetrations through the cavity (eg windows, air vents, overflow pipes).
- Where rigid insulation boards are used, an interlocking joint can help to maintain a continuous, unbroken layer of insulation.

SPECIFICATION NOTES

The specification notes for a wall with blown or injected cavity insulation as listed on page 5 are equally applicable to partial fill cavity insulation, except that stop ends on cavity trays are not required with partial fill.

In addition, there are a number of specification notes that are applicable only to partially filled cavity walls.

- Check that the height of the insulation boards or slabs is compatible with the coursing of the masonry being used, ie 455 mm high mineral wool slabs or 450 mm high rigid insulation boards for use with 225 mm blockwork coursing, and 405 mm high slabs or 400 mm high boards for use with 200 mm blockwork coursing.
- Consider specifying boards with interlocking edge profiles to prevent air from the cavity circulating behind the insulation.

BUILDABILITY POINTS

- In addition to the 50 mm clear cavity, add 5 mm to the thickness of the insulation boards when determining the structural cavity width, to allow for construction tolerances (see Diagram 10).
- Allow 10 mm for the dpc and associated mortar when determining the thickness of reveal insulation needed with special reveal blocks.
- Allow for the thickness of the dpc/cavity tray in addition to the dimension of the lintel within the cavity when determining cavity width (see Diagram 10).
- Site measurements show that the width of a cavity wall can vary in line and verticality by up to 10 mm. The introduction of factory-made components with fixed dimensions, such as insulated cavity closers into the cavity, needs to be considered in relation to these variations in tolerance. It is preferable to allow an extra 5 mm on the size of proprietary cavity closers when determining cavity width to avoid the possibility of the cavity being narrower than the closer.
- Where different sized openings are separated by short piers, consider using the same lintel height to ease detailing and construction.

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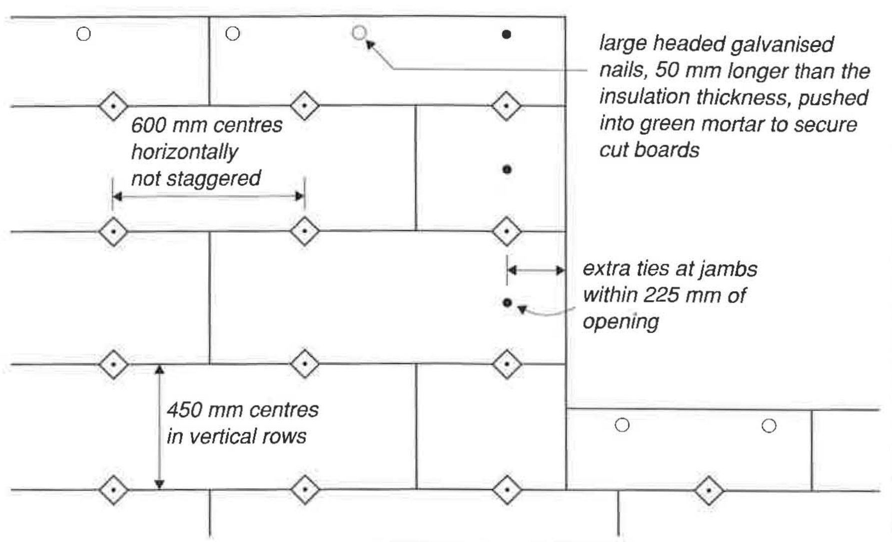

Provision of walls ties and clips with partial cavity fill

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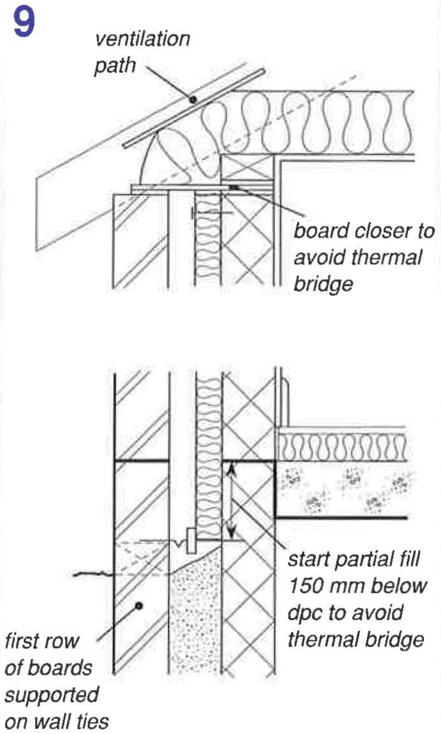
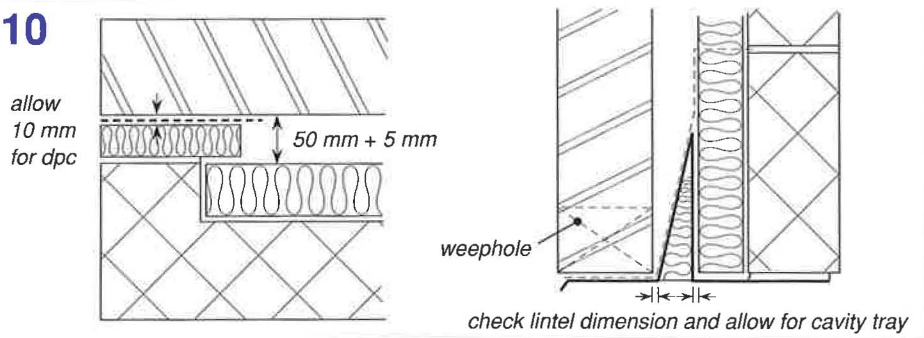


WALL/FLOOR JUNCTION

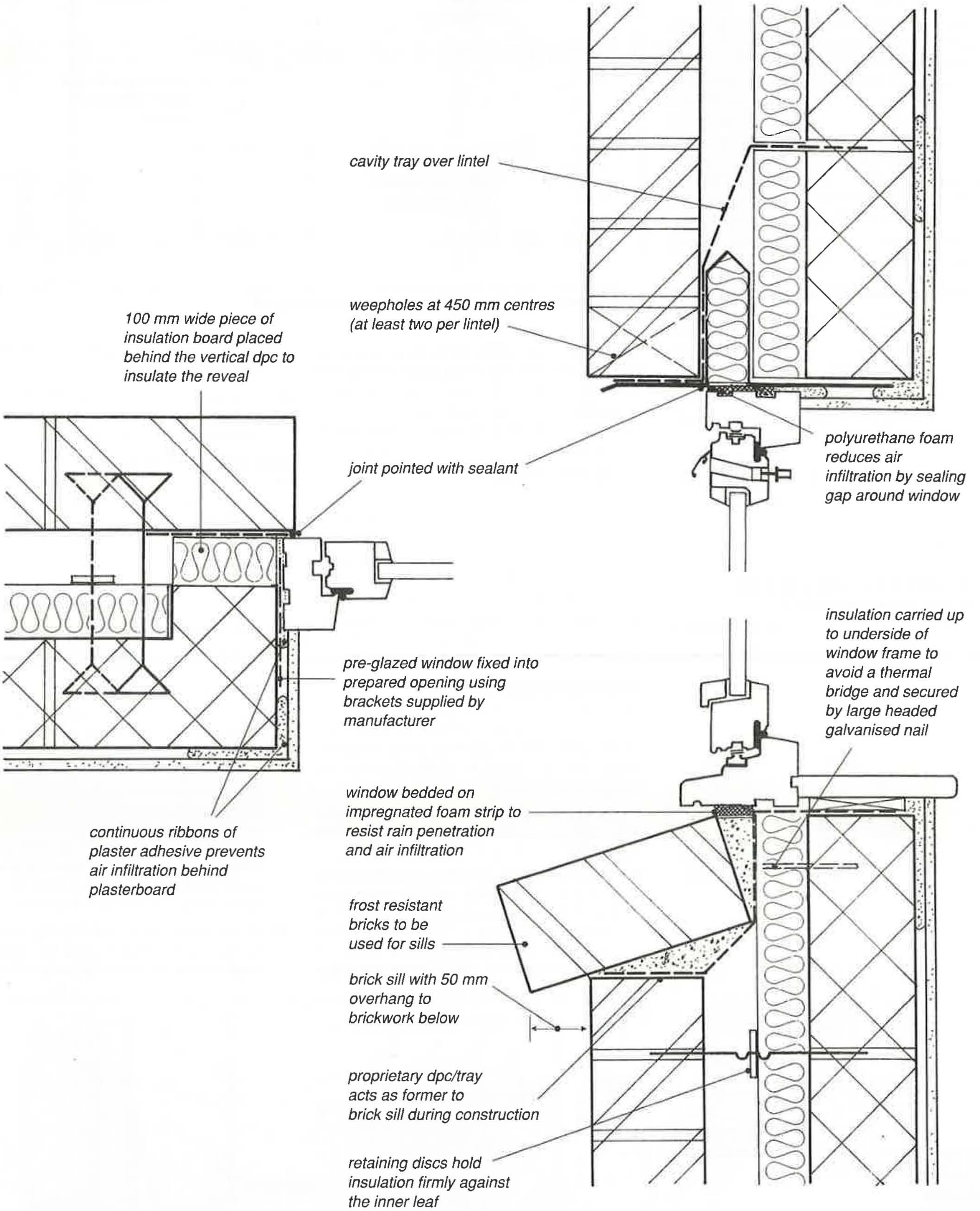
Ways of avoiding a thermal bridge

10



Allow for tolerances when specifying cavity width

Typical window opening detail in a wall designed for partial fill insulation



ENERGY EFFICIENCY IN NEW HOUSING

Detailing for designers and building professionals

INTRODUCTION

This Guide deals with cavity walls which are insulated using an insulation/plasterboard internal lining.

Detailing standards applicable to the masonry cavity wall should follow the recommendations in BS 5628 : Part 3. The specification and fixing of the insulated lining should be in accordance with the manufacturers' recommendations and Good Practice detailing described in this Guide.

CONSTRUCTION OPTIONS

The main construction options are:

- external finish
- type of masonry for both inner and outer leaves
- type and thickness of insulation materials to be used for the internal lining.

To achieve a U-value of 0.35 W/m²K without placing insulation in the cavity, it is necessary to use an insulating block such as aircrete or lightweight aircrete for the inner leaf and one of the thicker insulation/plasterboard laminates as the internal lining, as shown in table 7. Using aircrete blockwork for the outer leaf, behind render or cladding, enables a wider choice of insulation materials and thicknesses for the internal lining.

FEATURES

- Cavity may be left unfilled, retaining traditional construction techniques.
- It is easy to check that the cavity is clean and that wall ties and cavity trays are correctly installed.
- Insulation and internal finish applied in one operation.
- Disguises shrinkage cracks where lightweight aircrete blockwork is used.
- Reduces the thermal capacity of the building, and so improves the response time when an intermittent form of heating is installed.

As an alternative to using aircrete for the inner leaf, it is possible to use lightweight aggregate blocks that have an insulating core. These are produced by a number of manufacturers. Their thermal resistance *R* (typically 1.16 m²K/W) is better than 100 mm thick lightweight aircrete blocks and, when used in combination with an insulated dry lining, they can readily achieve U-values of 0.35 W/m²K or below. Many of these blocks are more than 100 mm thick and will therefore increase the overall thickness of the wall.

EXTERNAL CAVITY WALLS

Clear cavity with insulated dry lining

Masonry for cavity wall		U-values for linings with the following insulants and overall thicknesses (including 12.5 mm plasterboard) [W/m²K]					
Outer leaf	Inner leaf	Expanded polystyrene 50 mm	Extruded polystyrene 40 mm	45 mm	50 mm	Polyurethane 32 mm	40 mm
Fairfaced brickwork	Lightweight aircrete [480 kg/m³]				0.34		0.35
Fairfaced brickwork	Block with insulating core [*R*=1.16 m²K/W]		0.35	0.33	0.31		0.33
Rendered block [1500 kg/m³]	Lightweight aircrete [480 kg/m³]			0.35	0.33		0.35
Rendered aircrete [650 kg/m³]	Lightweight aircrete [480 kg/m³]	0.33	0.33	0.31	0.29	0.34	0.30
Rendered aircrete [650 kg/m³]	Aircrete [650 kg/m³]			0.35	0.32		0.34

KEY (shaded) combinations where the U-value is greater than 0.35 W/m²K, assuming no allowance is made for thermal bridging.

Note: Where cladding, such as tile hanging or timber boarding, is used in place of render, the insulation values will be slightly better.

Table 7 Construction options that achieve U-values better than 0.35 W/m²K

"When a cavity wall is lined with insulation there are potential thermal bridges at openings and at junctions with partitions, floors and separating walls"

MAIN TECHNICAL RISKS

The main technical risks with this form of construction are:

- **rain penetration** if the wall is not adequately protected from wind driven rain, if it is not designed and constructed to the standards set out in BS 5628 : Part 3, or if it is used in too exposed a location
- **thermal bridging** where insulation is not returned at reveals and soffits of window and door openings and at junctions
- **air infiltration** through the void behind the dry lining
- **interstitial condensation** if water vapour from within the dwelling finds its way through the dry lining to the colder masonry surfaces behind
- **PVC insulated electrical cables** in contact with expanded polystyrene can have a reduced life expectancy.

DETAILING AGAINST RAIN PENETRATION

The key detailing design points to resist rain penetration are set out on page 4. Recommendations on good practice appear in BS 5628 : Part 3, the BRE Report *Thermal insulation: avoiding risks* and the NHBC Guide *Thermal insulation and ventilation*.

The exposure rating for clear cavity walls with insulated dry lining and different external treatments is shown in table 8.

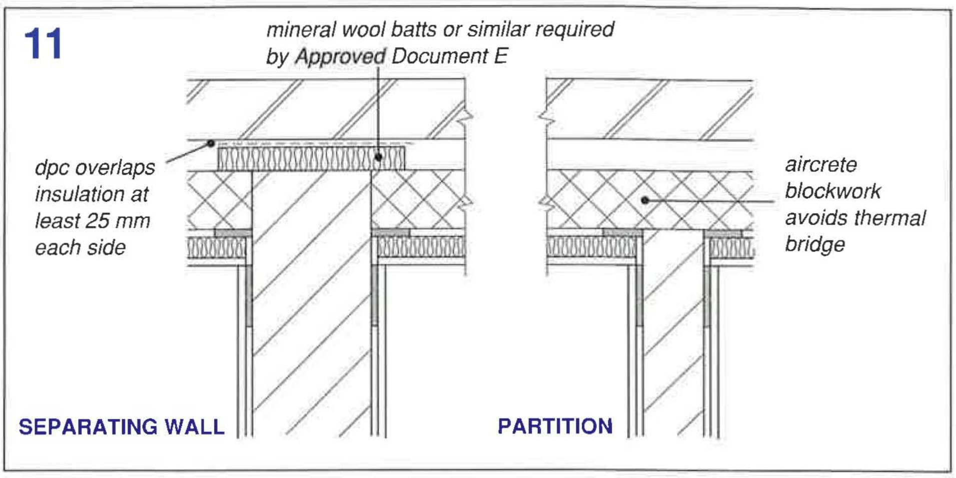
It should be noted that even with a clear cavity, recessed mortar joints should be used only in areas of Sheltered or Very sheltered exposure. Elsewhere mortar joints should have a tooled finish, ie weathered, bucket-handled or similar.

DETAILING TO AVOID THERMAL BRIDGING

When a cavity wall is lined with an insulation/plasterboard laminate, there is no thermal bridge through the wall itself, but there are potential thermal bridges at window and door openings and at junctions with internal partitions, floors and separating walls.

The use of standard or lightweight aircrete in the inner leaf (to achieve a U-value of 0.35 W/m²K) avoids thermal bridging problems at junctions with internal partitions and intermediate floors.

At separating walls a thermal bridge is avoided by closing the cavity with mineral wool (see Diagram 11). This also avoids flanking sound transmission and is a new requirement introduced into the 1992 Edition of Approved Document E (England and Wales). It is not a requirement of the Scottish *Technical standards*, or Technical Booklet G, *Sound*, in Northern Ireland.



Avoid a thermal bridge at junctions with internal walls

A thermal bridge around window and door openings can be avoided if the insulated dry lining is returned into the reveal and soffit. To avoid the window frame being masked by thick insulation boards, thinner boards of 25 mm overall thickness with 12.5 mm of insulation are sufficient at reveals and soffits (see Diagram 12).

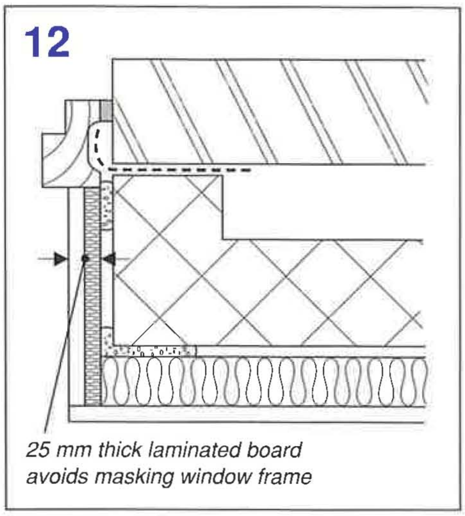
Where an insulated dry lining is used at the soffit, it is not usually possible to position a trickle ventilator in the head of the window frame. It will be necessary to choose a design of window frame that can accommodate a trickle ventilator in the head of the opening light.

DETAILING AGAINST AIR INFILTRATION

Air infiltration can be reduced by minimising the number of holes made in the masonry inner leaf, restricting the airpaths behind the dry lining and sealing all gaps at the perimeter of each area of dry lining and where services pass through it.

The **key detailing points** for walls with an insulated lining follow.

- Timber floors should be supported on joist hangers, not built into the inner leaf.
- Continuous ribbons of plaster should be used to bed the dry lining at the perimeter of each area of wall, at window and door openings and around service penetrations, such as electrical sockets.
- Specify a continuous ribbon of adhesive to seal gaps at all junctions of the lining with window and door frames, skirting boards, the underside of window boards and services, such as waste pipes and balanced flues, that pass through the lining (see Diagram 13).



Avoid a thermal bridge at the window reveal

Apply a continuous ribbon of adhesive around a socket outlet

External leaf	Clear cavity width [mm]	Maximum exposure category
Masonry with cladding or rendered finish	50	Very severe
Facing brick on ground storey with cladding or render to upper floors	50	Very severe
Facing brick (tooled mortar joints)	50 100	Severe Very severe
Facing brick (recessed mortar joints)	50	Sheltered

Table 8 Maximum exposure categories for walls with a clear cavity

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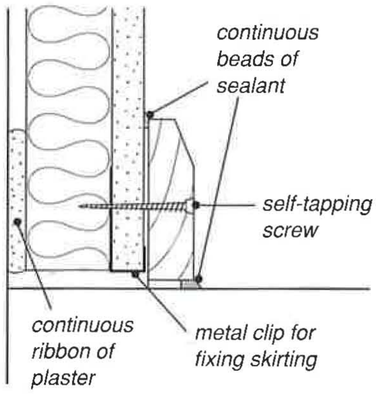


FIXING THE METAL CLIP


APPLYING SEALANT TO THE SKIRTING

Detailing to avoid air leakage at the skirting


Continuous ribbons of adhesive around the wall perimeter to minimise air leakage

DETAILING AGAINST INTERSTITIAL CONDENSATION

Interstitial condensation can be controlled by preventing water vapour passing through, and around the perimeter of, the dry lining. Where a vapour control layer is provided, it should be located on the warm side of insulation. Particular attention should be paid to rooms that generate high levels of moisture, ie bathrooms and kitchens.

The **key detailing points** for walls with an insulated dry lining follow.

- Choose a laminated thermal board with an integral vapour control layer.
- Seal the joints at the junctions with ceilings and floors to prevent moist air reaching the cavity behind the lining.
- Minimise the number of service penetrations through the dry lining. Seal around pipes and ducts that pass through the lining with expanding foam. Surround socket and switch outlets with continuous ribbons of plaster when fixing the thermal boards.

DETAILING TO AVOID CONTACT BETWEEN PVC INSULATED CABLES AND EXPANDED POLYSTYRENE

PVC insulated cables should not come into contact with expanded polystyrene as this can reduce their life expectancy.

The **key detailing point** for dry lining with an expanded polystyrene backing follows.

- Avoid direct contact between the insulation and PVC insulated electrical cables by always running the cables in trunking or conduit.

SPECIFICATION NOTES

- Materials for the wall should be chosen to suit the local exposure of the proposed building (see table 8).
- Avoid using too strong a mortar for facing brickwork as this can cause hairline cracks which downgrade the exposure rating of the wall.
- Porous bricks absorb rainwater and reduce the risk of rain penetration through mortar joints.
- Choose a type of wall tie that is suitable for the cavity width and compatible with the strength of the blockwork inner leaf.
- Choose stainless steel ties in Severe and Very severe exposure zones.
- Recessed joints encourage rain penetration and should be used only in Sheltered and Very sheltered exposure zones.
- Specify secondary mechanical fixings of the type and number recommended by the board manufacturer. These help to retain the plasterboard in position in a fire and so extend the period of protection provided to the combustible insulation backing.
- Choose plasterboard at least 12.5 mm thick where the insulation backing is combustible.
- Electrical cables should be run in conduit or trunking behind the dry lining.

BUILDABILITY

- Plan the position of heavy fixtures such as wall hung boilers, wall cupboards and radiators. With plastic or nylon anchor fixings, specify plaster dabs at fixing positions to prevent compression of the board. Alternatively specify that timber battens are plugged and screwed to the blockwork, as fixing blocks, before the insulated lining is fixed (see Diagram 14).
- For lightly loaded fixings, for such things as pipe clips, wall mirrors and bathroom fittings, choose a cavity type fixing that expands behind the plasterboard and compresses the insulation as the fixing is tightened.

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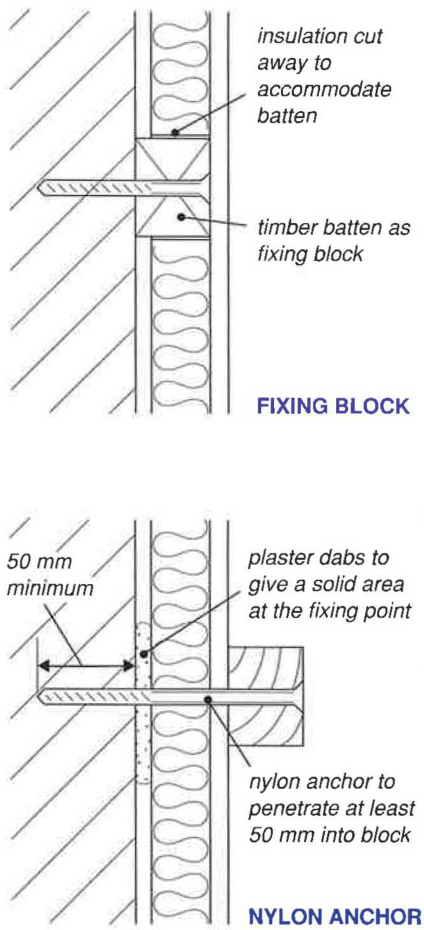
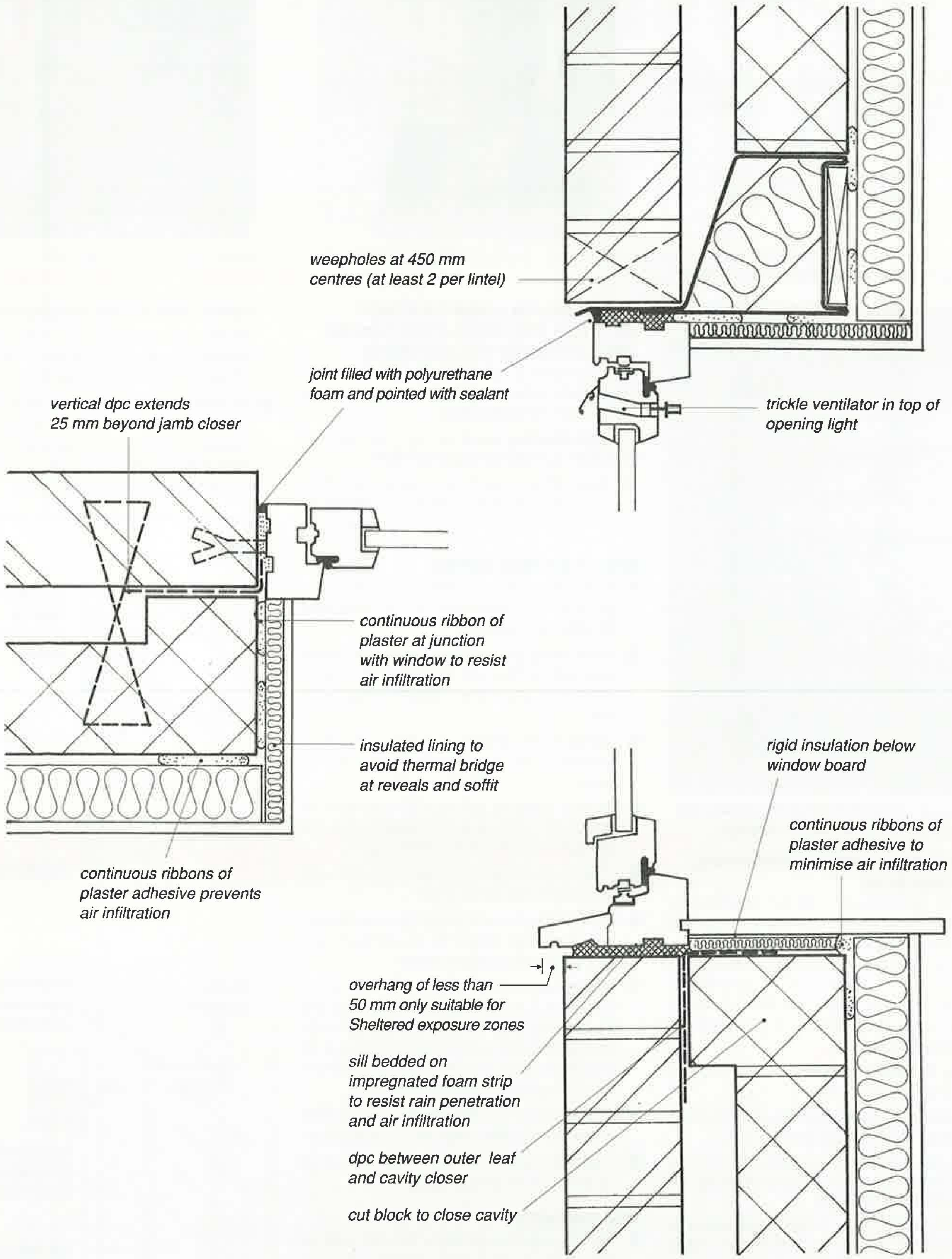


Alternative fixing methods for heavy fixtures

Typical window opening detail in a wall designed for an insulated dry lining



ENERGY EFFICIENCY IN NEW HOUSING

Detailing for designers and building professionals

INTRODUCTION

Services are often built into or pass through external walls. Careful detailing is necessary if services are not to weaken the integrity of the external wall as far as rain penetration, air infiltration, thermal bridging or fire risk are concerned.

This Section describes the main detailing aspects that are necessary in order to avoid these technical risks. It deals with the following items associated with services:

- vents, flues and ducts
- pipes
- meter boxes
- chimneys
- electrical cables and outlet boxes.

FEATURES

- Services that pass through the external wall should be sealed at the entry point to the dwelling to prevent air infiltration.
- Services that are built into the wall and interrupt the cavity, such as ducts and meter boxes should be provided with a cavity tray that extends at least 50 mm each side of the obstruction.
- Where blown or injected cavity insulation is to be used, it is recommended that all services passing through the cavity are either ducted or sleeved.
- Combustible insulation should not be used within 200 mm of the flue wall of a chimney that is suitable for a solid fuel appliance.

EXTERNAL CAVITY WALLS

Services and service entries

Many services pass through external walls

"Services are often built into or pass through external walls. Careful detailing is necessary if services are not to weaken the integrity of the wall"

Table 9 sets out the main technical risks for the services that are built into or pass through the external wall. Some of the detailing requirements to avoid these risks vary with the type of wall construction. Where applicable, this is noted in the text.

DETAILING AROUND DUCTS

There are a number of services that require sleeved ducts through a cavity wall. These include balanced flues to boilers, ventilation ducts serving extract fans or heat recovery units and air vents to the space beneath suspended ground floors.

These ducts vary in size and shape from 100 mm diameter to 225 x 225 mm rectangular. Their presence in the wall introduces the risk, not only of rain crossing the cavity, but also of air infiltration through the wall.

The **key detailing points** follow.

- Cavity trays should be placed over all rectangular ducts or sleeves that are built into the cavity wall. The cavity tray should extend at least 50 mm each side of the obstruction (see Diagram 15). Stop ends and weepholes are only necessary on cavity trays above ducts over 450 mm wide in walls with full fill cavity insulation.
- Circular ducts for items such as balanced flues and extract fans or sleeves need no cavity trays but should be fitted with drip collars to prevent rain that penetrates the wall tracking to the inner leaf.
- The gap between ducts or sleeves and the surrounding masonry should either be sealed with polyurethane foam filler or made good with mortar and finished with a bead of sealant (see Diagram 16).

Services \ Main risks	Fire risk	Rain penetration	Air infiltration	Thermal bridge
Air vents, balanced flues, extract ducts	–	✔	✔	–
Pipes passing through the wall	–	✔	✔	–
Electrical cables and boxes	✔	–	✔	–
Meter boxes	–	✔	–	✔
Chimneys	✔	–	–	✔

Table 9 The main technical risks associated with a range of services

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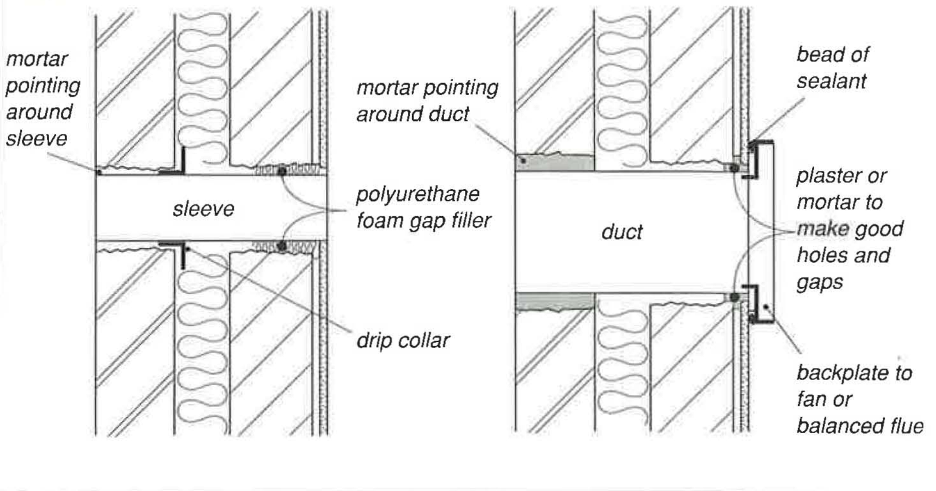

Alternative ways of avoiding air infiltration when ducts are retrofitted into a wall

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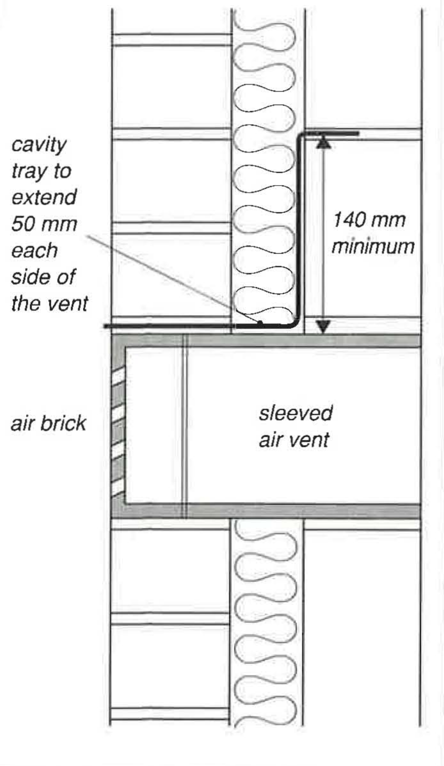

Detail of cavity tray over sleeved duct

DETAILING WHERE PIPES PASS THROUGH THE WALL

Overflow pipes, waste pipes, cold water pipes serving outside taps and incoming gas mains commonly pass through external walls.

The **key detailing points** follow.

- Gas and water pipes should be sleeved through the wall (see Diagram 17). Plastic waste and overflow pipes are not normally sleeved.
- All holes around pipes and sleeves should be 'made good' to prevent air leakage. Making good with mortar or plaster is common, but can leave hairline cracks after drying out. At internal surfaces, polyurethane foam gives a better seal and prevents air leakage. As polyurethane foam is degraded by ultra-violet light it should not be used externally, unless shielded from daylight.
- The gap between a pipe and its sleeve should be sealed with a non-setting mastic at each end to provide a 'gas tight' seal. This is sufficient to prevent air leakage.
- Gas and water pipes do not need a cavity tray.
- Where practical, pipes and sleeves should be laid with a slight fall to the outside.

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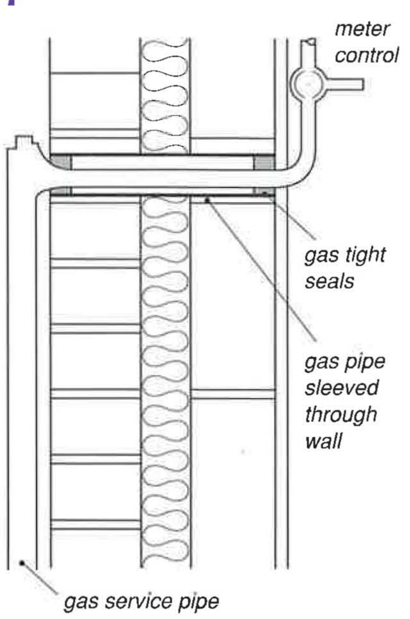
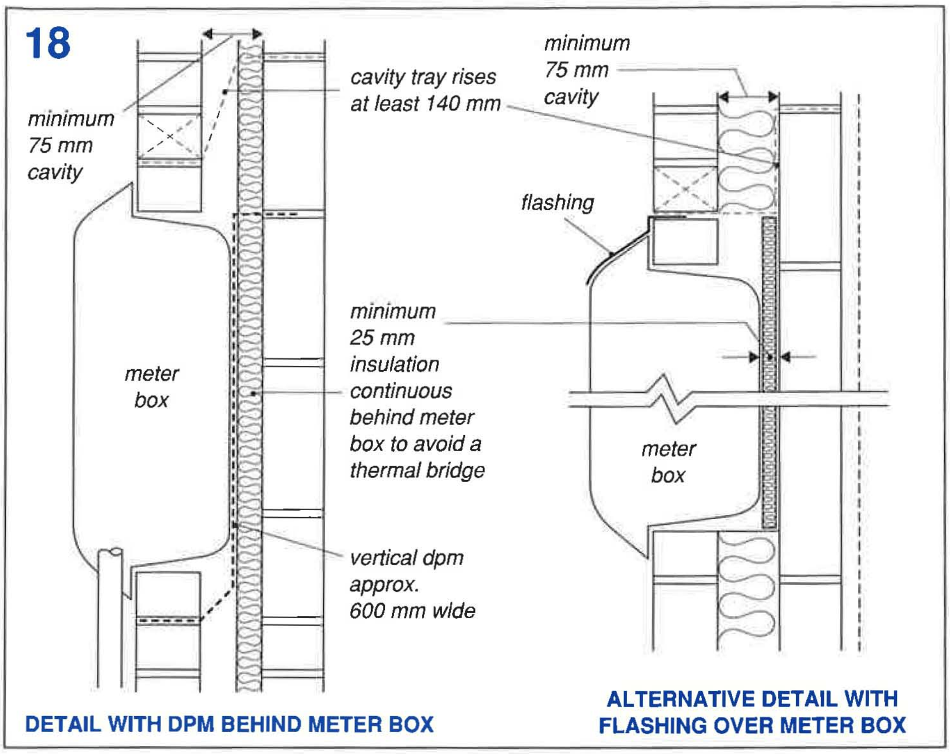


Detail of gas pipe sleeved through cavity wall



Details of built-in meter boxes

DETAILING AT CHIMNEYS

The type of chimney most likely to be built into an external wall is one that is suitable for use with solid fuel appliances. Such a chimney typically contains a flue liner in a 225 x 225 mm flue in section and is suitable for solid fuel appliances up to 45 kW output as well as solid fuel effect gas appliances.

Unless correctly detailed, chimneys can present a fire risk and a thermal bridge path.

The **key detailing points** follow.

- All combustible insulation materials should be separated from the chimney flue by 200 mm thick masonry. Most block-built chimneys have walls that are 100 mm thick, so cannot be used immediately next to combustible insulants such as polystyrene and polyurethane. Mineral wool insulation, being non-combustible, is suitable for use next to chimney flues (see Diagram 19).
- To avoid creating a thermal bridge, the wall insulation should continue uninterrupted around the chimney.
- 'Warm' chimneys are more efficient at removing flue gases than 'cold' chimneys. So it is preferable for chimneys to be detailed on the 'warm' side of the insulation. This also has the added benefit that heat from the chimney can help to warm the house, rather than be lost to the outside air.

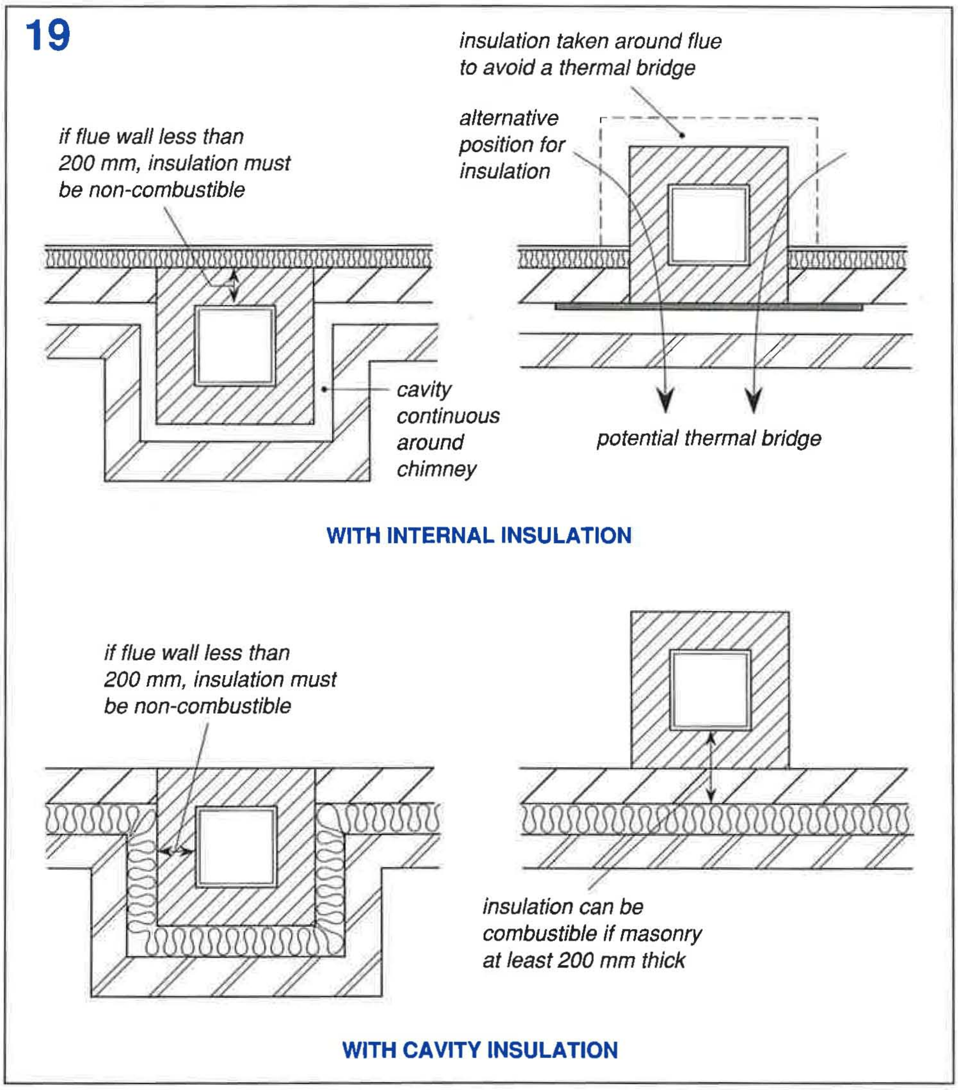
DETAILING AT METER BOXES

Built-in meter boxes for gas and electricity are designed to be incorporated into the external leaf of cavity walls. The meter boxes project about 50 mm into the cavity and can present a risk of rain penetration if attention is not paid to damp proofing. Where cavity insulation is used, the interruption of the insulation by the meter box can also present a thermal bridge.

These risks can be avoided by locating the meters in a garage, or for gas, by using an external ground level meter box.

The **key detailing points** for built-in meter boxes follow.

- Purpose designed meter boxes provided by British Gas or electricity companies can be built into the wall without the need for a lintel to support the wall above, unless two are located side by side.
- A cavity tray should be installed above the meter box and extend at least 50 mm each side.
- To prevent water running down the back of the meter box casing and reaching the inner leaf provide either:
  - a flashing dressed over the top edge of the meter box and tucked under the cavity tray, or
  - a vertical dpm behind the meter box (see Diagram 18).
- To avoid a thermal bridge at the back of the meter box, where cavity insulation is being used, either:
  - use aircrete for the inner leaf or preferably,
  - detail the meter box so that a 25 mm thick insulation board can be placed behind the meter box where the full thickness of cavity insulation cannot be accommodated. This requires the cavity to be at least 75 mm wide, if the meter box is fully inset.



Detailing around chimney

ELECTRICAL CABLES AND BOXES

The normal position for electrical cables on external walls is just below the internal surface finish. No electrical cables should be located in the cavity of an external wall, except the incoming meter tails.

The **key detailing points** follow.

- PVC insulated electrical cables should not come into contact with polystyrene insulation, since this can reduce their life expectancy. Where thermal boards with a polystyrene backing are used to insulate external walls, PVC insulated electrical cables should be suitably protected, eg routed in conduit.
- Where dry lining or thermal boards are used to line external walls, measures should be taken to avoid air infiltration at socket outlets, wall switches, etc. This can be most easily achieved by providing a solid ribbon of bedding adhesive around each electrical box when fixing the dry lining.

SPECIFICATION NOTES

- Specify backdraught shutters to extract fans to reduce unwanted air leakage when the fans are not in operation.
- Electrical cables that pass through the external wall (eg to serve external lighting) should be run in conduit.
- To prevent the risk of serious overheating when covered by insulation on one side, the following circuits should have their cable sizes increased:
  - 30 amp cooker control units
  - 30 amp radial circuits supplying either a 6 kW shower unit or socket outlets.
- Insulation blocks that have a hollow core filled with insulation should not be chased for services, unless specifically permitted by the block manufacturers. The maximum size of chases in solid blockwork are shown in Diagram 20.
- Materials used to seal around pipes that pass through a masonry wall should allow for some movement to take place, whilst still maintaining an airtight seal. Foamed polyurethane is recommended where gaps are large and irregular in shape. A caulking sealant, such as acrylic, is suitable for small, regular gaps.
- Plastics materials should be used in preference to metal for sleeves and ducts in order to minimise the effect of thermal bridging.
- Specify ground level gas meters to avoid penetrating the external wall.

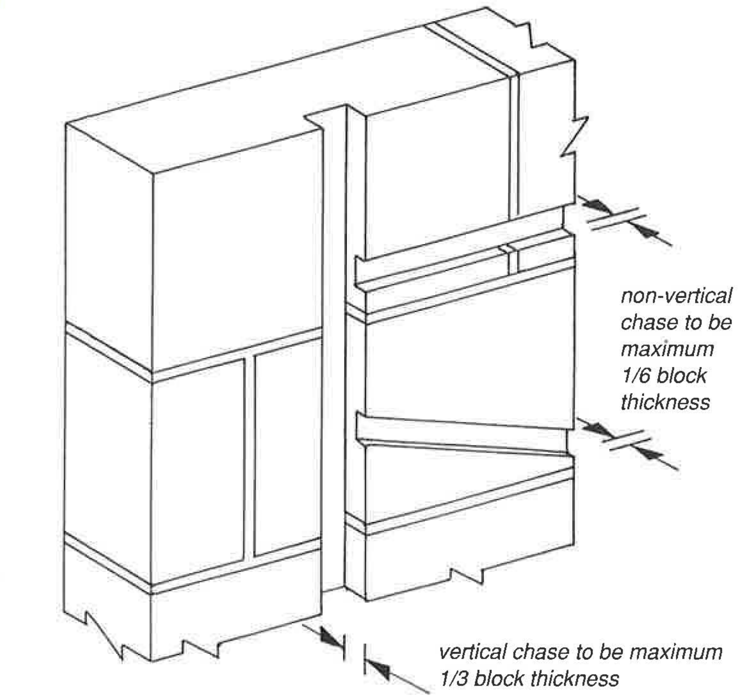
BUILDABILITY POINTS

- Where individual meter boxes are built in during construction, there is no need for a lintel. However, a lintel or timber template is necessary if the meter box is installed later in the construction sequence.
- Where blown in cavity insulation is specified, all services that pass through the cavity should be ducted or sleeved. This requires that the position of balanced flues and ducting to extract fans be accurately planned in advance and a sleeve or duct built into the wall, either together with the insulation or, for walls to receive injected or blown insulation, before the insulation is installed.
- If it is unavoidable to form holes for flues and extracts after the walls are built, care should be taken not to damage or leave gaps in the insulation.
- Compared to full fill systems, walls with partial cavity insulation are more likely to suffer from rain penetration when services are retrofitted, since drilling the wall can dislodge the insulation and cause pieces of broken masonry to bridge the residual cavity.

Continuous ribbon of adhesive around electrical box to reduce air infiltration

Overflow pipe sealed with polyurethane foam to prevent air infiltration

20



Maximum permitted sizes of chases in solid blockwork

Opening formed for meter box

ENERGY EFFICIENCY IN NEW HOUSING

Detailing for designers and building professionals

INTRODUCTION

To assess the ability of a masonry cavity wall to resist rain penetration, three steps are necessary.

1 Determine the exposure category of the wall to wind driven rain.
2 Select a form of wall construction that is suitable for that exposure category.
3 Use appropriate details for the exposure category.

This Section enables the designer to determine the exposure category of a building and gives guidance on suitable forms of masonry cavity construction. The other Sections of this Guide include guidance on appropriate forms of detailing for the various exposure categories.

For the workmanship standards that are necessary if the wall is to achieve the exposure category rating for which it has been designed refer to BS 5628 : Part 3, the BRE report BR143, *Thermal insulation: avoiding risks* or EEO Good Practice Guide 5 on external masonry walls.

If workmanship is unlikely to be to BS 5628 standards, the exposure rating of the wall should be reduced.

FEATURES

- BS 5628 : Part 3 uses six regional exposure categories:

Very severe	Sheltered/moderate
Severe	Sheltered
Moderate/severe	Very sheltered

- The exposure of a wall is affected by local as well as regional conditions, including location on the site, topography, orientation and elevation.
- Resistance to rain penetration is affected by:
  - the type and position of wall insulation
  - the width of the structural cavity or residual air space
  - the type and extent of the applied external finish, if any.
- In areas of Very severe exposure most masonry wall constructions require cladding.
- Recessed mortar joints to fairfaced masonry are only suitable for areas which are Sheltered or Very sheltered.

EXTERNAL CAVITY WALLS

Assessing exposure to driving rain

		Highest permitted exposure category for each construction				
		IMPERVIOUS CLADDING		RENDERED FINISH		FAIRFACED MASONRY
		All wall	Above F/F masonry	All wall	Above F/F masonry	All wall
FULL FILL [mm]						
Built-in	50	VS	S	S	S	Sh/M
	75	VS	S	S	S	S
	100	VS	VS	S	S	S
RETRO FILL [mm]						
(except UF foam)	50	VS	Sh/M	S	Sh/M	Sh
	75	VS	S	S	S	S
	100	VS	VS	S	S	S
UF FOAM [mm]						
	50	VS	Sh/M	S	Sh/M	S
	75	VS	Sh/M	S	Sh/M	Sh/M
PARTIAL FILL [mm]						
Residual air space (min.)	50	VS	S	S	S	S
CLEAR CAVITY [mm]						
Cavity width (min.)	50	VS	S	VS	S	S
	75	VS	VS	VS	VS	VS

Key VS = Very severe
S = Severe
Sh/M = Sheltered/moderate
Sh = Sheltered

"The exposure of a wall is affected by local as well as regional conditions, including location on the site, topography, orientation and elevation"

ASSESSING EXPOSURE TO DRIVING RAIN

DETERMINE THE DEGREE OF EXPOSURE

The first step in selecting a suitable wall construction is to determine the exposure category for the most vulnerable piece of wall in the building.

The map below shows the variation in exposure categories across the country for walls which face the prevailing wind and have a clear line of sight to open country. For example:

- a gable wall, on the edge of a site, which has an unobstructed view to open countryside
- a wall which is set back from the edge of a built-up area, but which has a clear view of open country between other buildings
- the wall of a taller building, which projects above the surrounding buildings within a built-up area.

The most exposed external wall in a building, usually the tip of a gable wall, should be used when making an assessment of the degree of local exposure. Buildings that have no clear line of sight to open country but are sheltered by surrounding buildings and trees can be considered to have a lower exposure to wind driven rain than that shown on the map.

Their exposure category can be lowered as follows:

- to Moderate/severe in areas of Very severe exposure
- a reduction of one category for other exposure categories.

In making the assessment of the exposure category, it is important to use local knowledge and experience, particularly where sites are:

- in elevated positions that face the prevailing wind
- in open terrain with little shelter, such as moorland, open farmland or coastal areas.

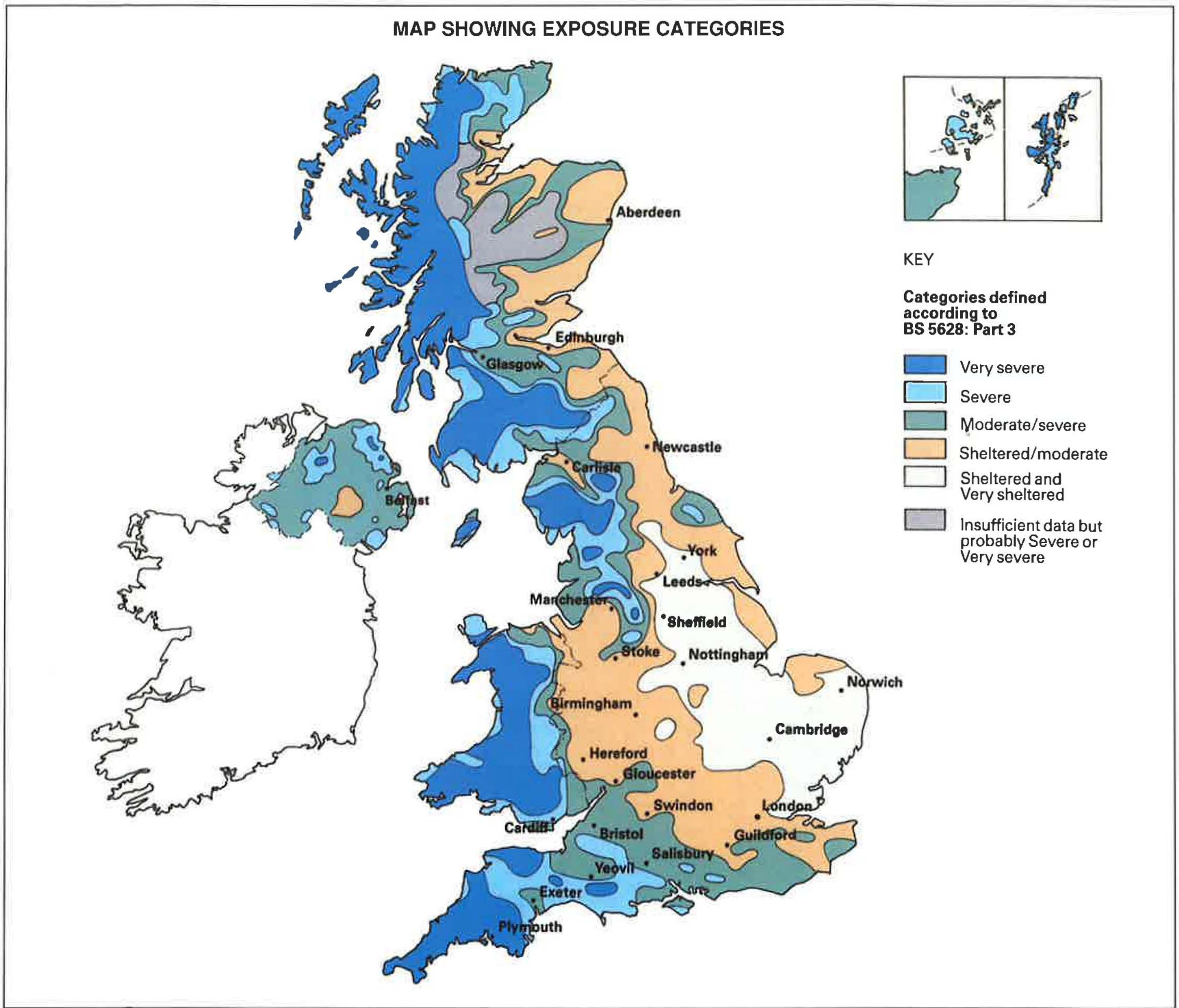
In such cases, the appropriate exposure category for particular walls may be higher than that indicated by the map. BS 8104, *Code of Practice for assessing exposure of walls to wind-driven rain* contains a detailed method for taking such local factors into account when determining the degree of exposure of individual walls to driving rain.

BACKGROUND INFORMATION ON THE CLASSIFICATION OF EXPOSURE CATEGORIES

The map below is taken from BRE Report 143 *Thermal insulation: avoiding risks.*

The map uses six exposure categories ranging from Very sheltered to Very severe. This classification is based on an analysis of the worst likely spell of wind-driven rain falling, on average every three years, on a wall facing the prevailing wind.

This information is arrived at using an analysis of meteorological data and takes the form of a **local spell index.** BS 5628 : Part 3 uses the local spell index to define the six exposure categories used in the map. However, because the exposure categories overlap each other, the contour lines on the map can only indicate the approximate division between zones. For areas that are close to the contour boundaries, the designer should take account of local experience and factors, such as topography, in deciding which is the most appropriate exposure category.



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